what is generally implied by "nature study." He is perfectly capable of appreciating the elementary conceptions of anatomy and physiology. He is, moreover, fully alive to questions of sex, and is ready to assimilate a clean scientific view of its meaning. Personally I should find it very difficult to teach either botany or zoology apart from one another to these young boys.

Botany may be offered as a subject both for the Lower and School Certificates; but there is no indication from higher authority as to what should be included in a course of zoology for boys of this standard. It has been necessary, therefore, to substitute special syllabuses in biology of our own making, in order to enforce the inclusion of zoology in the examinations. Two examples are quoted below of the zoological content of biological syllabuses for the Lower Certificate:

A. Boys of 14½-15½, working four hours a week for three terms.

Elementary outlines of anatomy of following: Earthworm, Frog, Rabbit.

Prevention and destruction of insect pests, Elaters (wireworms), Tipulidæ (leather jacket), Aphididæ (woolly aphis).

Special scheme of Research Work.

(*a*) British Bird Life: (i.) Embryology; (ii.) General Anatomy of Birds. The mounting of specimens, examination of beaks and crops in connection with cultivation.
(*b*) Coleoptera, Lepidoptera, Hymenoptera.
(*c*) Anatomy of Farm Animals.
(*d*) Diseases of Animals; Blood.
(*e*) Insect Pests of English Fruit Trees.

One group only has been taken by any boy. Special work has been done by the whole form in preparation of charts, recording agricultural operations, bird life, etc., during the different seasons, and meteorological observations taken daily.

B. Boys of 14-15, working two hours a week for three terms.

A general knowledge of the Natural History of animals, with special reference to British forms (*e.g.* Rabbit, Pigeon, Frog, Snail, Butterfly, Spider). The study of pond life.

The general facts of fertilisation, and embryology of the frog and chick.

Use of the microscope for the study of Protozoa and Crustacea, also for parts of higher animals (*e.g.* scale of fish, feather, squamous epithelium from human cheek).

A general idea of organic evolution.

The above syllabuses, and others of a similar nature, have been successfully carried out. They are, however, open to criticism as not being suitable for wide application, especially in schools where monetary considerations constitute a limiting factor. In the absence of a recognised syllabus for a first introduction to zoology, and with a view of showing how the subject can usefully be introduced in any school, the writer has prepared a small text-book, the zoological syllabus of which is as follows:

Frog—External features, mode of life, respiration, alimentation. Development; breeding, segmentation, tadpole life, metamorphosis.
Earthworm—Habitat, mode of life, external features, general dissection, reproduction, soil action.
Fishes—Dogfish and Cod; habitat, mode of life, external features, development. Scales as a means of age-determination.
Arthropods — Crayfish, Bluebottle Fly, Garden Spider; habits, external features, life-cycle. Comparative table and summary of leading characteristics of each class.
Insect Pests—(An introduction to economic zoology.) Cabbage White Butterfly, Winter Moth, Cockchafer, Bean Weevil, Click Beetle (wireworm), Bean Aphis, Crane-fly (leather jacket), Larch Saw-fly.
Skeleton of the Vertebrate Fore-limb—Perch, Frog, Pigeon, and Rabbit. Comparative table.
Elementary conceptions of Variation and Heredity. Evolution.
The Microscope—Its use; suitable objects for observation. The nature of living matter; the cell. (For schools where the microscope is available.)

This syllabus is in close accordance with the general scope of teaching advocated by the British Association Committee, but is so condensed as to be covered by one hour's work a week throughout one school year. Types which, either through their limited distribution or their expense, may be difficult to obtain have been omitted; it is fatal to begin the study of zoology from a book instead of from an animal.

Finally, although a precise syllabus is necessary for the successful prosecution of class work during school hours, the best interests of zoology will never be served by that means alone. The museum and the aquarium must be going concerns, continually renewed and augmented by voluntary labour cheerfully given out of play-hours.

E. W. Shann.

The School, Oundle, May 16.

Every teacher of biology in public schools will naturally welcome both the original memorandum of the British Association and also the article signed F. K. in Nature of May 13, p. 628. The greatest difficulty in the teaching of biology at public schools at the present time is the position of the teacher. Unlike the teacher of so many other subjects the biologist is not turned out more or less a master of his subject, but is just in a position to begin to learn it, and the subject or subjects are so vast that if he is to do his work conscientiously he has a life's task before him. Of course this is more or less true of every other subject, but I think I am not in serious error when I say that a man with a good classical degree probably finds himself sufficiently well equipped to cope with the really intelligent boys of the upper sixth of the average public school.

So vast is the subject of biology, however, that the teacher cannot hope to cope with the really clever boy unless he is a real student of his subject, and even then of course his influence is that of a slightly superior but at the same time a fellow student, and not that of a master.

The teacher of biology, if he is to carry on his work successfully, must have an average knowledge of a great deal besides his text-book of botany or zoology. He must have a practical working knowledge of microscopy, pond-life, marine biology, field botany, including a reasonable knowledge of mosses, lichens, rusts, and other fungi. One knows, of course, that the mind of the average schoolboy is somewhat limited, but there are always a few that are capable of doing really good work, and for such boys the position of the master must be either one of suppression or that of a fellow-student, and one is seriously led to think that too often the work of the teacher is an act of suppression.

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To sum up the whole position, a teacher of biology must be prepared to make his subject his life's work. It is lamentable, however, that even in some of the greatest of our public schools there is little room for the progressive student. The chief form of recognition or promotion consists of extra duty, and it is just this extra duty that puts an end to the idea of study. If a man is to teach biology properly he cannot hope to satisfy the demands of the head-master who looks for a colleague who will take an active part in the games of the school and a commission in the Corps, etc., and yet unless a man does do these things his chances of success in the scholastic world are poor. Of course things are improving and the high standard of work demanded by university scholarships is making the position of the true teacher a more important one.

I do not think, however, that F. K. is quite just when he advocates a vigorous protest against the opinions of examiners. The universities are naturally anxious to get hold of the best boys available, and they are surely the best men to select their material. We know that all examinations are more or less unsatisfactory, but they are the only possible method. The chief fault lies in the lack of co-ordination between the university and the public school, and this is not altogether the fault of the university.

A. G. LOWNDES.

α-Particles as Detonators.

WHEN an α-particle passes through matter it may be considered that the matter in the proximity of the path of the swiftly moving particle is momentarily raised to a high temperature. Looked at in this light the action of an α-particle may be likened to that of a detonator and it may be possible to detonate a sufficiently unstable substance by the action of these particles. This has been found to be the case with the familiar explosive compound, nitrogen iodide.

The experiment forms a rather striking lecture demonstration. Nitrogen iodide is prepared in the usual way by the mixture of finely ground iodine and strong ammonia and allowed to dry overnight in the open air. On bringing a fairly strong radioactive source (say the active deposit of radium) within 3 or 4 cms. of the compound the iodide explodes. It may readily be shown by the use of screens of suitable thickness placed over the source that the result is due to α and not to β or other rays.

Detonation is not caused by the first α-particle which happens to strike the substance, but seems to be a probability effect. With a button of nitrogen iodide of about $0 \cdot 1$ cm.^{2} area a source of radium-C equivalent in γ-ray activity to about 3 mg. of radium placed 1 cm. away causes the button to explode in about 20 seconds, *i.e.* when between 10^7 and 10^8 α-particles have struck it. Increasing the size of the button or the strength of the source decreases the time necessary. Quantitative measurements are not very accurate, as it is difficult to ensure identical conditions of experiment. Doubtless other unstable compounds might be found which would also be exploded in this manner.

G. H. HENDERSON.

Cavendish Laboratory, Cambridge, May 23.

Active Hydrogen and Nitrogen.

Two brief comments are suggested by the interesting work of Dr. F. H. Newman on the activation of hydrogen and nitrogen described in the *Philosophical Magazine* for March. The failure of the reaction product of the active nitrogen with sulphur, phosphorus, and iodine to give a test for nitrides is not evidence of the absence of a chemical reaction between those elements and nitrogen, for all three are more electro-negative than nitrogen and the compounds formed would be sulphides, phosphides, and iodides, respectively. That this is in fact the case is shown in some experiments of mine with Dr. A. C. Grubb, which are now in process of publication, in which tests for sulphides and phosphides were actually obtained after exposing the corresponding elements to a stream of active nitrogen formed in the corona discharge. Our experiments did not include iodine.

Further, the evolution of gas when the bulb, in which these same three elements had been exposed to active hydrogen, was heated from −40° C. to 100° C. is not evidence of the failure of these elements to react with the active hydrogen, for the compounds formed would be hydrogen sulphide, phosphine, and hydrogen iodide, all of which are gaseous at the latter temperature though liquefied at the former, and would thus be evolved in the gaseous form when heated to increase the pressure as noted. Here again my experiments with Dr. R. S. Landauer and with Dr. William Duane, already published, show that phosphine and hydrogen sulphide are actually formed, the latter being confirmed by the dynamic method of Dr. Newman.

GERALD L. WENDT.

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IN reply to the comments made by Prof. Wendt, although no traces of the nitrides of sulphur, phosphorus, and iodine were found in the experiments on the activation of nitrogen, this was not unexpected, as it was considered highly improbable that any chemical compounds formed would respond to the nitride test. As the absorbed gas was not reliberated on heating, it appeared that chemical combination had taken place, the compounds so produced being very stable. Several other elements actually formed nitrides with the active nitrogen. These two facts suggested that chemical compounds were produced. The experiments of Prof. Wendt, now in the course of publication, seem to confirm this view.

As regards the action of active hydrogen on these three elements, it was found that at temperatures above 0° C., absorption of the gas occurred, although at a decreased rate. At these temperatures, if the chemical products formed are hydrogen sulphide, phosphine, and hydrogen iodide, they must be present in the gaseous state. There are other factors to be considered in order to account for the disappearance of the hydrogen, for the production of these gases will not explain the decrease in pressure. They are probably "trapped" within the solid present in the tube, and only reliberated on heating. Some of the gas which was evolved on the application of heat was re-absorbed when an electric discharge was passed through it, or when exposed to α-ray radiation. This re-absorbed gas was hydrogen, which may have been produced by the dissociation of the chemical compound formed originally, or it may have disappeared originally by occlusion within the solid. Although chemical action does account for the disappearance of some of the hydrogen, other processes, such as occlusion, have to be taken into account.

F. H. NEWMAN.

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